[SPECIFICATION]

[TITLE OF THE INVENTION]

RADIO PROTOCOL IN IMT-2000 MOPBILE CPMMUNICATION SYSTEM

[BRIEF DESCRIPTION OF THE DRAWINGS]

FIG. 1 is a block diagram showing a RRC for UTRAN in the next generation mobile communication system in accordance with the present invention in detail;

FIG. 2 is a block diagram showing a radio protocol architecture and RRC for UE in the next generation mobile communication system in accordance with the present invention in detail;

FIG. 3 is a block diagram showing a. radio protocol architecture and RLC for UE in the next generation mobile communication system in accordance with the present invention in detail; and

FIG. 4 is a block diagram showing a radio protocol architecture and RLC for UTRAN in a next generation mobile communication system in accordance with the present invention in detail.

Description of main part in drawings

100, 200: Radio Link Control Layer (RLC)

110, 210: RLC-Transparent entity

120, 220: RLC-UNACK **130, 230: RLC-ACK**

150, 250: multiplexing/demultiplexing block

[DETAILED DESCRIPTION OF THE INVENTION]

[OBJECT OF THE INVENTION]

[FIELD OF THE INVENTION AND BACKGOUND OF THE RELATED ART]

The present invention relates to a next generation mobile communication system and more particularly to a protocol on radio access standards based on Universal Mobile Telecommunication system (UMTS) being developed and standardized by the European Telecommunication Standard Institute (ETSI).

Today, as the society is developed to a highly information oriented society, the communication network is developing to one unified radio system which can deal with all services.

As a new communication field, though the mobile communication has been grown rapidly up to now, services of the mobile communication up to now are mostly for speech and are available only in restricted regions. However, it is foreseen that the future mobile communication system can transmit not only speech, but also even character, image, and multimedia information, and services of which will be made available in any place in the world by means of an international perfect roaming.

Particularly, since the joint development of a second generation mobile system called DCS-1800 which serves the

Global System for Mobile Communication (GSM) at a 1800 MHz frequency band, in Europe, lead by the ETSI, is under development of the UMTS.

The UMTS is a next generation mobile communication scheme developed independently based on the Code Division Tested (CODIT) and the Asynchronous Time Multiplexing Access (ATDMA), which are researches on the radio access standards of which UMTS is conducted as one of projects of the Research and Development in Advanced Communication Technology in Europe (RACE).

Basically, the radio access standard protocol architecture suggested by the UTMS until now includes, from the bottom, a Physical Layer (PHY), a Medium Access Control Layer (MAC), a Radio Link Control Layer (RLC), a Radio Resource Control Layer (RRC), and a Higher layer.

However, those protocol layers are still being developed to be implemented in the next generation mobile communication service. That is, there has been ceaseless demand for selecting the appropriate protocol architecture which meets objective criteria of the radio access standards such as spectrum efficiency, range of service and power efficiency, and the subjective criteria of the radio access standards such as complexity of the system, service quality, flexibility of radio technology and network, and

portability.

[TECHNICAL SOLUTION OF THE INVNETION]

An object of the present invention is to provide a radio protocol for the next generation mobile communication system and a method for managing the mobile communication system. The radio protocol includes a RLC which conducts radio link control functions according to a data transmission mode for supporting a variety of the next generation mobile communication services which will be developed in the future.

To achieve the objects and in accordance with the purposes of the present invention, as embodied and broadly described herein, the radio protocol for a next generation mobile communication system includes a radio link control layer for connecting to an upper layer through a service access point provided in advance and for connecting to a lower layer through a plurality of logical channels also provided in advance. The radio link control layer includes at least one radio link control entity for transmission/reception of data to/from the up-link or down-link according to the form of the data transmission mode.

Preferably, the radio link control layer includes a RLC-transparent entity either for receiving an SDU from the upper layer, dividing the SDU into a plurality of PDUs and

providing the PDUs to the lower layer, or for receiving the plurality of PDUs from the lower layer, reassembling the PDUs into an SDU and providing the SDU to the upper layer, a RLC-unacknowledged entity(hereinafter abbreviated to a 'RLC-UNACK') either for receiving the SDU from the upper layer, conducting framing in which the SDU is divided into a plurality of PDUs wherein a header is inserted into each of the PDUs and providing the PDUs to the lower layer, or for receiving a plurality of PDUs from the lower layer, separating as header from each of the PDUs, reassembling the PDUs into the SDU depending on presence of error and providing the SDU to the upper layer, and a RLC-acknowledged entity (hereinafter abbreviated to a 'RLC-ACK') for correcting an error in the PDU or retransmitting the PDU depending on the presence of an error in the plurality of PDUs received from the lower layer.

The radio link control layer further includes a multiplexing/demultiplexing block for multiplexing the PDUs so that some of the provided radio link control entities are connected to the lower layer through the plurality of logical channels.

[SYSTEM AND OPERATION OF THE INVENTION]

In a radio protocol architecture for the next generation mobile communication system, a MAC switches

transport channels according to a monitoring result of a channel state to process multiple dedicated logical channels.

Also, the Frequency Division Duplexing (FDD) or the Time Division Duplexing (TDD) may be implemented as the transmission-reception separating system in the next generation mobile communication system. The RLC protocol architecture of the present invention support the FDD, and can also support the TDD for certain cases.

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

FIG. 1 illustrates a block diagram showing a detail of RRC for a Universal Terrestrial Radio Access Network (UTRAN) in a next generation mobile communication system in accordance with the present invention, and FIG. 2 illustrates block diagram showing a radio protocol architecture and RRC for UE in a next generation mobile communication system in accordance with the present invention.

The RRC architecture model of the present invention is provided for supporting a UMTS control plane and a FDD mode, and can also support a TDD mode.

Referring to FIG. 1, the RRC 10 in a communication

system of the present invention provided for the next generation mobile communication system is disposed between an upper layer and a lower layer. The upper layer for radio transmission control and for mobile station management includes a Call Control (CC) entity, a Mobility Management (MM) entity, a Radio resource Management entity and a Packet Management entity. The lower layer includes a PHY 40, a MAC 30, and a RLC 200.

In this instance, the RRC 10 includes a Broadcast Control Entity(BCE) 11 for controlling broadcast information provided from a user side Access Stratum (AS) or Non Access Stratum (NAS), called an upper layer collectively; a Paging and Notification Control Entity (PNCE) 12 for providing paging and notification information from the upper layer; a Dedicated Control Entity (DCE) 13 for providing services on setting/canceling connection and transmission of a message from the upper layer, and a Transfer Mode Entity (TME) 14 for mapping (fixing a transport path) the BCE 11, the PNCE 12 and the DCE 13 to an access point of the RLC in the lower layer.

A method for controlling a radio resource by the aforementioned network side RRC of the present invention will be explained. The present invention provides separate entities for processing different messages according to the

messages transferred between the RLC 200 and the upper layer or the lower layer, or between the upper and the lower layer.

First, characteristics of the message to be transported from the upper layer to the RRC are made known. The characteristics of the message to be transported from the upper layer to the RRC are determined. Namely, whether the message is broadcast message information, paging and notification information, or information on setting / canceling connection and transmission of a message from the upper layer is transmitted to the DCE 13.

The message provided to the RRC 10 is processed in one of the following three message processing procedure depending on a service function of the message.

That is, the RRC 10 of the present invention has the BCE 11 for processing a message only required for transmission, the PNCE 12 for processing the paging message or the notification message, and the DCE 13 for processing an important message, such as a packet or speech.

The TME 14 next determines a transfer mode of the message processed in the preset signal processing procedure and determines a path for forwarding the message, i.e. conducts a mapping according to the characteristics and transfer mode of the message.

That is, the TME 14 controls how to map from the BCE 11, the PNCE 12, or the DCE 13 in the RRC to a Service Access Point (hereinafter abbreviated to a 'SAP') (T-SAP, UNACK-SAP and ACK-SAP) of the RLC 200.

In this instance, comparing the received message form and the present service form, the BCE 11 is mapped to either a Transparent-SAP (T-SAP) or an Unacknowledged-SAP (UNACK-SAP), the PNCE 12 is mapped to either the T-SAP or the UNACK-SAP, and the DCE 13 is mapped to one of the T-SAP, the UNACK-SAP or an Acknowledge-SAP (ACK-SAP).

The BCE 11 controls the demultiplexing of an upper layer message received by a peer entity from another upper layer entity (for example, the user side MM entity), and controls multiplexing of a lower layer message received from a sub entity (for example, a BCE in UTRAN) of the RLC 200.

The BCE 11 supports an upper layer service using a General Control Service Access Points (GC-SAPs), and may use a lower layer (RLC 200) service provided by the T-SAP, or UNACK-SAP. In this instance, the T-SAP transmits a message from an upper layer to the RLC 200, and the UNACK-SAP requires no confirmation on received message.

The PNCE 12 controls demultiplexing of an upper layer message received by a peer entity from another upper layer

entity (for example, the user side (UE) MM entity), and controls the multiplexing of a lower layer message received from a sub entity (for example, a PNCE in UTRAN) of the RRC 10.

The PNCE 12 supports the upper layers through Notification-SAPs (hereinafter abbreviated to a 'NT-SAPs'), and may use a lower layer (RLC 200) service provided through the T-SAP or UNACK-SAP.

The DCE 13 controls the demultiplexing of an upper layer message received by a peer entity from another upper layer entity (for example, the MM entity in the user entity and a RNAP in network (UTRAN) side), and controls the multiplexing of a lower layer message received from a sub entity (for example, UE and a DCE in UTRAN side) of the RRC 10.

The DCE 13 supports the upper layers through a Dedicated Control-SAPs (DC-SAPs), and can use a lower layer (RLC 200) service provided through the T-SAP, ACK-SAP, or UNACK-SAP. The ACK-SAP transfers a message from the upper layer to the lower layer (RLC 200) and requests for confirmation on the message transfer, so that the upper layer makes confirmation on transfer of the message.

In a RRC in the UE use state as shown in FIG. 2, upon reception of a message at the RLC 100 in the lower layer,

the RLC 100 determines characteristics of the message, and forwards the message to the TME 14 in RRC 10 through T-SAP, UNACK-SAP or ACK-SAP depending on the characteristics. The TME 14 transfers a message received through the T-SAP, UNACK-SAP, or ACK-SAP in the RLC 100 to one of the BCE 11, PNCE 12 and the DCE 13. That is, the message is transferred to respective entities 11, 12 and depending on whether the message is a broadcast message, paging and notification message or a message, such as speech or packet. Then, the BCE 11, the PNCE 12 and the DCE 13 process the message signal according to the characteristics of the respective entities, and transfer the processed signal to the upper layer through the GC-SAPs, NT-SAPs and DC-SAPs in the RRC 10.

FIG. 3 and FIG. 4 illustrate radio protocol architecture in a next generation according to the present invention.

FIG. 3 illustrates a block diagram showing a radio protocol architecture and RLC for UE in a next generation mobile communication system in accordance with the present invention and FIG. 4 illustrates a block diagram showing a radio protocol architecture and RLC for UTRAN ion a next generation mobile communication system in accordance with the present invention.

The present invention will be explained centered on FIG. 3 as the radio protocol of the UTRAN shown in FIG. 4 is almost the same with the radio protocol in the UE shown in FIG.3.

Referring to FIG. 3, the RLC 100 is provided with different SAPs for access to the upper layer, such as T-SAP, UNACK-SAP and ACK-SAP.

The RLC control between the upper layer and the RLC 100 will be explained in detail. The entities 110, 120 and 130 in the RLC 100 have different forms of data transfer modes and functions.

The RLC-Transparent (hereinafter abbreviated to a 'RLC-T') entity 110 controls a data flow to logical channels, such as SCCH, BCCH, PCCH, and DTCH, through a logical channel SAP connected to the MAC. The RLC-T 110 is provided with both a segmentation block 111 and a transmitter buffer block 112 in an up-link from the UTRAN and, as will be explained later, a RLC-T 210 in FIG. 4 is also provided with a segmentation block 211 and a transmitter buffer block 212 in a down-link from the UE.

The RLC-T 110 is also provided with a reassembly block 113 and a receiver buffer block 114 in a down-link from the UTRAN, and the RLC-T 210 has a reassembly block 213 and a receiver buffer block 214 in an up-link from the

UE.

When the UE is viewed as a transmitter side, the RLC-T 110 receives a Service Data Unit (hereinafter abbreviated to a 'SDU') from the upper layer at first. Then, the segmentation block 111 in the RLC-T divides the SDU into a plurality of Protocol Data Units (hereinafter abbreviated to a 'PDUs'), each having no header, and transfers the PDUs to the MAC through the transmitter buffer block 112.

Opposite to this, when the UE is viewed as a receiver side, the RLC-T 110 receives PDUs through a receiver buffer block 114 from the MAC. Later, a reassembly block 113 of RLC-T entity 110 reassembles the received PDUs as SDUs to transmit to the upper layer.

RLC-Unacknowledged (hereinafter abbreviated to a 'RLC-UNACK') entity 120 controls a data flow to logical channels, such as SCCH, BCCH, PCCH, CCCH, DCCH, and DTCH through a logical channel SAP connected to the MAC.

The RLC-T 120 is provided with segmentation & concatenation 121, framing block 122, Transmitter buffer 123, UTRAN in FIG 4 is also provided with a segmentation & concatenation 221, and framing 222 and Transmitter buffer 223.

RLC-UNACK entity 120 is also provided with Reassembly 124, Duplication detection 125, error detection 126,

deframing block 127 and receiver buffer 128 in a upper link, and UTRAN in FIG. 4 is also provided with Reassembly block 224, Duplication detection block 225, error detection block 226, deframing block 227, and receiver buffer block 228.

Here, when the UE is viewed as a transmitter side, the RLC-T 120 receives a SDU from the upper layer at first, then, RLC-UNACK entity 120 devides the received SDU into a plurality of PDUs with a Header by framing to be transmitted to the MAC through a transmitter buffer block 123.

When the received SDU is divided into PDU at the same time concatenation is performed, which is the process to insert part of the next data in the PAD of PDU.

Opposite to this, when the UE is viewed as a receiver side, the RLC-T 120 receives PDUs through a receiver buffer block 128 from the MAC.

Later, deframing block 127 of RLC-UNACK entity 120 divides a Header from the received PDUs, detecting whether each PDU has an error or not.

If an error is detected in the received PDU, corresponding PDU is deleted, and other PDUs which don't have errors are detected again to know whether they are duplicated or not.

If duplicated PDUs are detected among the above PDUs, the corresponding PDUs are delivered to reassembly block 124 once.

Reassembly block 124 reassembles the PDU as SDUs to be transmitted to the upper layer.

RLC-ACK entity 130 controls a data flow to logical channels, such as DCCH, and DTCH through a logical channel SAP connected to the MAC.

The RLC-T 130 is provided with both a segmentation block 131, a framing block 132, a flow control 133, an error correction & retransmission 134 and a transmitter buffer block 135 in an up-link from the UTRAN and, as will be explained later, the UTRAN in FIG. 4 is also provided with the same blocks above 231~235 in a down-link from the UE.

The RLC-T 130 is also provided with a In-sequence delivery of upper layer PDU 136, a reassembly block 137, a flow control block 138, Duplication detection block 139, an error correction block 140, an error detection block 141, a deframing block 142 and a receiver buffer block 143 in a down-link from the UTRAN, and the UTRAN is provided with the same blocks above 236~243 in an up-link from the UE.

When the UE is viewed as a transmitter side, the RLC-T 130 receives a SDU from the upper layer at first. Then,

the segmentation & concatenation block 131 in the RLC-T divides the SDU into a plurality of PDUs, each having a header by framing, and at the same time, concatenation process is also performed so that adequate PDUs are divided.

Accordingly, RLC 100 processes the speed of transmission according to flow status information of peer RLC, later RLC 100 detects whether it gets acknowledgement from peer RLC or not.

Here, if it is detected that it doesn't get acknowledgement from each PDU, and RLC 100 multiplexes the present transmitter PDU and then, retransmits the corresponding PDU.

When these operation of RLC-ACK entity 130 in an upper link, RLC 100 transmits corresponding PDU to a MAC through transmitter buffer 135.

Opposite to this, when the UE is viewed as a receiver side, the RLC-T entity 130 receives PDUs through a receiver buffer block 128 from the MAC. Later, a deframing block 142 of RLC-T entity 130 detects whether an error exists or not in the PDU after dividing Headers from the received PDUs by deframing block 142.

If an error is detected in the received PDU, RLC 100 requests the peer RLC not given acknowledgement to

retransmit, then RLC 100 redetects whether the received PDU is duplicated or not.

Here, if a duplicated PDU is detected among them, the corresponding PDU is transmitted to flow control block 138 once. Later, RLC 100 transmits data flow state to the peer RLC, reassembling PDUs as SDUs, and maintain PDU row to be transmitted to the upper layer.

The following TABLE 1 shows functions of UE according to each RLC entity 110, 120, and 130.

[TABLE 1]

	Entity function Logical channel		SCCH	BCCH	PCCH	CCCH	DCCH	DTCH
Up-link (TX)	RLC-T entity							V
		Segmentation						V
	RLC-UNACK entity					V	V	V
		Segmentation				V	V	V
		Concatenation				V	V	V
		Framing				V	V	V
								V
	RLC-ACK entity						V	V
		Segmentation					V	V
		Concatenation					V	V
		Framing					V	V
		Flow control					V	V
		Error correction (retransmission)					V	V
	RLC-T entity		V	V	V			V
		Reassembly	V	V	V			V
	RLC-UNACK entity		V	V	V	V	V	V
		Deframing	V	V	V	V	V	V

Down-link (RX)		Error detection	V	V	V	V	V	V
		Duplication Detection	V	V	V	V	V	V
		Reassembly	V	V	V	V	V	V
	RLC-ACK entity						V	V
		Deframing					V	V
		Error detection					V	V
		Error correction					V	V
		Error correction (NON-ACK)					V	V
		Duplication detection					V	V
		Flow control					V	V
		Reassembly					V	V
		In-sequence delivery of upper layer PDUs					V	V

In addition, TABLE 2 shows functions of each RLC entity 210, 220, and 230 of UTRAN in FIG. 4.

[TABLE 2]

	Entity function Logical channel		SCCH	BCCH	PCCH	CCCH	DCCH	DTCH
Up-link (TX)	RLC-T entity		V	V	V			V
		Segmentation	V	V	V			V
	RLC-UNACK entity		V	V	V	V	V	V
		Segmentation	V	V	V	V	V	V
		Concatenation	V	V	V	V	V	V
		Framing	V	V	V	V	V	V
	RLC-ACK entity						V	V
		Segmentation					V	V
		Concatenation					V	V
		Framing					V	V
		Flow control					V	V

		Error correction (retransmission)					V	V
Down-link (RX)	RLC-T entity							V
		Reassembly						V
	RLC-UNACK entity					V	V	V
		Deframing				V	V	V
		Error detection				V	V	V
		Duplication Detection				V	V	V
		Reassembly				V	V	V
	RLC-ACK entity						V	V
		Deframing					V	V
		Error detection					V	V
		Error correction					V	V
		Error correction (NON-ACK)					V	V
		Duplication detection					V	V
		Flow control					V	V
		Reassembly					V	V
		In-sequence delivery of upper layer PDUs					V	V

The present invention further has new functions except for the RLC functions explained in Table 1 and 2. The new functions are framing and deframing functions, which control separation/combination of Header inserted to PDU. The said structure of RLC is related to the state of RLC data transmitter mode and RLC functions.

[EFFECT OF THE INVENTION]

As explained above, if applying for a radio protocol for the next generation mobile communication system, it efficiently controls RLC between an upper layer, RRC and a lower layer, MAC so that it is efficient to realize a variety of services which the next generation mobile communication pursues.